

CLAIMS

1. A vapor flow controller apparatus for delivery of chemical reagent vapors from a liquid phase source material, said controller comprising:

- (a) a source container containing said liquid phase source material;
- 5 (b) a pump to transport said liquid phase source material to a vaporizer module, said pump having a flow rate controller;
- (d) said vaporizer module having a source material inlet, a carrier gas inlet, and a vaporized gas outlet, said vaporizer module adapted to convert said liquid phase source material to a vapor;
- 10 (e) a source material conduit for passage of said liquid phase source material from said source container to said source material inlet of said vaporizer module;
- (f) a carrier gas container containing a carrier gas, said carrier gas container having a carrier gas outlet conduit controlled by a mass flow controller;
- 15 (g) and
- (g) said flow rate controller adapted to provide flow of said liquid phase source material into said vaporizer module through said source material conduit at a desired mass flow rate, said mass flow controller adapted to provide flow of said carrier gas at a corresponding controlled rate such that said liquid phase source material is vaporized and then is entrained in said carrier gas and carried out of said vaporizer module through said vaporized gas outlet.

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2. The vapor flow controller apparatus of claim 1, wherein said source container is at ambient temperature.

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3. The vapor flow controller apparatus of claim 1, including a particulate filter on said source material conduit.

4. The vapor flow controller apparatus of claim 1, wherein said corresponding controlled rate provided by said mass flow controller is approximately 10 standard cubic centimeters per minute to approximately 5 standard liters per minute.

5. The vapor flow controller apparatus of claim 1, wherein said vaporizer module comprises a vaporization chamber and a source of heat on an evaporative surface.

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6. The vapor flow controller apparatus of claim 1, wherein said vaporization chamber is a quartz vaporization chamber.

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7. The vapor flow controller apparatus of claim 1, wherein said source of heat is a radiant energy device.

8. The vapor flow controller apparatus of claim 7, wherein said radiant energy device includes at least one quartz-iodine lamp and a focusing mirror.

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9. The vapor flow controller apparatus of claim 1, wherein said source of heat provides energy sufficient to heat and maintain said evaporative surface in a range within an approximate temperature range of 80 degrees Celsius to 420 degrees Celsius.

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10. The vapor flow controller apparatus of claim 1, wherein said source of heat is a resistive heating device.

11. The vapor flow controller apparatus of claim 1, wherein said source of heat is an inductive heating device.

12. The vapor flow controller apparatus of claim 1, wherein said vaporizer module 5 includes a thermal sensor to sense temperature of said evaporative surface.

13. The vapor flow controller apparatus of claim 12, including an electronic control module that regulates a duty cycle of said source of heat, based on a signal from said thermal sensor, to maintain said evaporative surface at a constant temperature.

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14. The vapor flow controller apparatus of claim 1, wherein said vaporized gas outlet provides flow of said vapor to a reactor for use in manufacture of semiconductor devices.

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15. The vapor flow controller apparatus of claim 5, wherein said liquid source material has a latent heat of vaporization associated therewith which cools said evaporative surface, said cooling counteracted by said source of heat, wherein power input to said source of heat to maintain said evaporative surface at a constant temperature is directly proportional to mass flow of said liquid source material provided out said vaporized gas outlet.

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16. The vapor flow controller apparatus of claim 1, wherein said pump comprises inert gas in a pressurized inert gas container, said inert gas container having an outlet and an inert gas conduit between said inert gas container outlet and said source container, and said flow rate controller is an adjustable pressure regulator to regulate 25 pressure of said inert gas in said inert gas container.

17. The vapor flow controller apparatus of claim 16, wherein said pressure regulator provides for flow of liquid phase source material in a range within an approximate range of 0.1 grams/minute to 35 grams/minute.

5 18. A vapor flow controller apparatus for delivery of chemical reagent vapors from a liquid phase source material, said controller apparatus comprising:

- (a) a source container containing said liquid phase source material;
- (b) an inert gas in a pressurized inert gas container, said inert gas container having an outlet regulated by an adjustable pressure regulator;
- 10 (c) an inert gas conduit between said inert gas container outlet and said source container;
- (d) a vaporizer module having a source material inlet, a carrier gas inlet, and a vaporized gas outlet, said vaporizer module adapted to convert said liquid phase source material to a vapor;
- 15 (e) a source material conduit for passage of said liquid phase source material from said source container to said source material inlet of said vaporizer module;
- (f) a carrier gas container containing a carrier gas, said carrier gas container having a carrier gas outlet conduit controlled by a mass flow controller;
- 20 and
- (g) said pressure regulator adapted to provide flow of said inert gas through said inert gas conduit, into said source container such that said liquid phase source material is forced into said vaporizer module through said source material conduit at a desired mass flow rate, and said mass flow controller is adapted to provide flow of said carrier gas at a corresponding controlled rate such that said liquid phase source material is vaporized

and then is entrained in said carrier gas and carried out of said vaporizer module through said vaporized gas outlet.

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